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INNOVATION ABSTRACTS

# Connecting Old Knowledge and New Knowledge

Imagine two college students are having the following conversation.

A: Did you fix it?
B: No.
A: No? Why not?
B: The place was closed by the time I got there.
A: Then how are you going to get to class tomorrow?
B: I guess I'll take the bus.

What were the two students taking about? If you said a car, then you are absolutely right! Although a car wasn't explicitly mentioned, you knew what it was because your mind recalled previous knowledge and connected it to what you heard in order to determine what the students were discussing. This Innovation Abstracts explores this phenomenon, but let me start by explaining a problem I've been dealing with for a few years.

Teaching advanced courses at a community college is rewarding and challenging for any faculty member. Many instructors enjoy teaching these second-year courses because of the advanced content presented and the refined thinking students undergo while developing their analytical and decision-making skills. However, teaching these courses comes with a formidable challenge for instructors. When teaching upper-division courses, using science as an example, instructors must help students recall and connect knowledge gained in prerequisite courses to new material presented in the current course. If you're not convinced that this challenge is real and significant for instructors, ask yourself this simple question:

"How can I help my students recall prior knowledge and connect it to new material without squandering a significant portion of instructional time?"

To put this problem into context, I will describe a situation I consistently encounter when teaching Organic Chemistry I and II. The prerequisite for Organic Chemistry is two semesters of General Chemistry that provide the necessary chemical conceptual foundation for students. Once students enroll in Organic Chemistry, the first and most important topics reviewed and expanded upon are acids and bases. Much of students' understanding of organic chemical reactions depends on their understanding of these topics! If students do not have a solid understanding of acids and bases, they will likely struggle throughout the semester. The situation is exacerbated when students move on to Organic Chemistry II, which is mostly structured upon reactions and mechanisms. Students are expected to be ready to expand upon the theories learned in prerequisite courses and take on new theories with higher degrees of complexity. This, in many cases, is an unexplored and untested process for students. They may wonder, "How can we remember all the information from General Chemistry when there's even more to learn in Organic Chemistry?" or "It feels like we are taking two courses at one time." Clearly, these concerns are important and must be addressed by instructors.

In Summer 2013, I decided to take a class on learning theories. The content covered everything from behaviorism to constructivism and everything in between. One theory caught my interest because I realized how important it was to me as a student and as an educator. This theory is known as Schema Theory, which describes how information is stored, organized, and retrieved from an individual's memory if the right "clues" are introduced. This is precisely how you may have correctly guessed what the college students were conversing about at the beginning of this article. Every day, our brains are exposed to a huge influx of information that can easily overwhelm them. Therefore, our brains use an efficient and less stressful way of retrieving and relating past events, features, and other information to new incoming information. You knew it was a car that the students were referring to because you have information about the function of a car stored in your memory. Moreover, our brains use prior knowledge to interpret new events and anticipate their outcomes. To enable someone to activate prior knowledge, Schema Theory calls for the use of "advance organizers." Advance organizers are instructional clues that help students reactivate prior knowledge.

Excited and equipped with an effective technique for helping students reactivate prior knowledge and connecting it to new knowledge, I implemented advance organizers when it came time to review acids and bases. I did this NOT by reviewing the topic as I have in past years. Instead, I used a KWL chart, which has three columns. One column is for "what do I Know?" The second column is for "What do I Want to learn?" And the third column is for "What did I Learn?"

I asked students to brainstorm anything associated with acids and bases and write it down under column K. Next, I asked students to anticipate what they would be learning about acids and bases. While this column should mainly be for student-generated questions, the instructor has to prepare a few questions in addition to the students' questions in order to allow the students to focus on the essential aspects of the topic. Finally, I assigned a short reading from the textbook to students and asked them to fill out the L column after finishing the reading. This part required them to write down what they learned about the topic.

Another advance organizer I used was a problem-based scenario. In that exercise, I provided students with a two-paragraph paper that contained a scenario involving a research chemist encountering a problem in his synthesis of a product due to the acidity of certain compounds. The students had to read the scenario, answer a few questions that required them to make inferences based on their prior knowledge, and ultimately, suggest a solution to the chemist's problem. What followed was a remarkable discussion by students that resulted in them constructing a reasonable solution to the problem.

By analyzing the impact of both activities on students and their results, I found that (1) less time was spent on reviewing old material because students used more effective strategies to recall their prior knowledge, (2) students were more attentive to the acid-base theory in subsequent lectures in class, and (3) students were more likely to establish the connection between what they already knew and what they needed to know.

Schema Theory and advance organizers apply to other disciplines, as well. For example, advance organizers can be any of the following: KWL charts (What do I Know? What do I Want to learn? What did I Learn?), concept maps, Venn diagrams, scenario inferences, storytelling, or problem-based discussions. Instructors of humanities can introduce and teach the different aspects of Roman civilization by asking students to identify key aspects of Greek Civilization, which can be covered in a previous course or chapter. History instructors can use a problem-based discussion on the causes of World War II by discussing why World War I occurred. Political science instructors can ask students to draw a concept map of the American political system and then compare and contrast the system to another political system using a Venn diagram. Calculus instructors can play a video of how algebra is different from calculus, and then demonstrate how the slope of straight line in algebra relates to differentiation.

In summary, instructional time is simply too precious to be squandered on techniques that consume huge chunks of time reviewing material from previous semesters or units. Take advantage of students' prior knowledge to prepare them to take in new information and synthesize new knowledge. Schema Theory is an educational theory that can be used effectively given the knowledge our students already possess and the fact that it can be employed across all disciplines to connect old knowledge and to new knowledge.

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